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MAGNETIC RESONANCE IMAGING OF THE THUMB BASE IN SEVERE SYMPTOMATIC OSTEOARTHRITIS: A PILOT STUDY

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Objectives: To assess the usefulness of MRI in symptomatic osteoarthritis of the thumb base and to identify the most suitable MRI sequences with or without Gadolineum contrast.
Methods: Eleven consecutive hand OA patients with predominantly unilateral thumb base symptoms reporting pain in that joint of at least 5 on an 0-10 scale participated. We used a 0,2T Artoscan-Dedicated MRI system from ESAOTE, Italy. The coil used was a dual phased array wrist coil. The MRI sequences were all in the coronal plane; High Resolution Gradient Echo (TR580, TE16), Gradient Echo STIR (TR1120, TE16), Turbo 3D T1 (TR40, TE16) and Spin Echo T1 (TR600, TE26) before and after i.v. Gadolineum. Two radiologists scored the conventional radiographs according to the OARSI atlas with modification for the STT joint. In addition they scored the following aspects on a 0-3 scale for both the CMC1 and the STT joints; Synovitis (SYN) (based on capsular hypertrophy and joint effusion), bone marrow edema (BME), cysts/erosions (CE) and osteophytes (OP). Consensus scores were reached at a second reading.
Results: Cumulative MRI and radiograph scores for the 22 joints studied were strongly correlated for both CMC1 (R 0.8, $p<0.001$) and STT joints (R 0.71, $p<0001$). Both BME and SYN in the CMC1 joint correlated with rest pain (R 0.54, p=0.01 and R 0.47, p=0.03 respectively). BME was also associated with pain intensity on the 0-10 scale (R 0.43, p=0.04). Other variables showed little association with pain. Interreader agreement on MRI scores varied considerably and was best for BME and CE in the CMC1 joint but less for SYN and OP as well as for the STT joint. Difficulties were in determining the soft tissue involvement of OA, especially demarcating the joint capsule of CMC1 and ligament pathology. The most informative MRI sequences were the High Resolution Gradient Echo, the STIR and the 3D volume. Gadolineum contrast provided little additional information in this study.
Conclusions: MRI is a promising method for the assessment of thumb base OA. The information regarding bone marrow edema and synovitis adds a new dimension to the understanding of pain in the CMC1 joints, particularly as these conditions may warrant different therapeutic approaches. Further work is needed to identify the most suitable sequences and to standardize the reading of the MRI images.

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MEASURING MALALIGNMENT IN KNEE OA

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Aim of Study: To compare a computer-based program for measuring frontal plane leg alignment with a hand-measuring system.
Methods: Five patterns of frontal limb alignment, simulating full-length radiographs of healthy and malaligned limbs, were drawn in AutoCAD and exported as digital images. The patterns included variations in varus and valgus alignment, joint space slope, and femoral and tibial shapes. Copies of each pattern were given to 7 trained readers for analysis. The readers used a ruler and protractor to measure predefined angles and lengths following an established method which defines limb and joint margin landmarks to derive mechanical and anatomic (shaft) axes (JBJS 1991; 73-B:16). Custom software that provided straight line, ruler, circle and midline tools was used to define the same landmarks on the digital copies of the patterns; the angles and lengths were calculated by the software, replicating the method above. A simple fixed calibration factor was used to convert the digital linear dimensions to their paper equivalent. The order of hand and computer analysis of the 5 patterns was randomized and each was repeated daily for 3 days. Measured angles included hip-knee-ankle (HKA), femoral condylar tangent-hip (CH), tibial plateau tangent-ankle (PA), condylar-plateau (joint orientation-CP) and angles between the femoral mechanical axis (FM), femoral shaft axis (FS), tibial mechanical axis (TM) and tibial shaft axis (TS). Femoral, tibial and apparent leg lengths were also measured. Repeated measures analysis of variance was performed to compare the methods, with a significance level set at $p<0.05$.
Results: The analysis revealed differences between hand and computer measures in femoral lengths and apparent leg lengths (although these differences were less than 1 mm). Differences between methods were also obtained for CP and FM-FS angles (the differences in angles were less than 1 degree). The variance of the computer measures was the same as (19/55 measures) or significantly less than (35/55 measures) the hand measures with the exception of angle CH on a single pattern. For all limb length measures and the angles HKA, FM-FS, FM-TS and FS-TS there were differences between the readers. There was no difference across days for any measure. Anecdotally, the time required to complete the hand measures was more than twice as long as that required for the computer measures and additional time was required for data entry and verification of the hand measures.
Conclusions: The analysis revealed similar results for limb alignment angles and for limb lengths between hand and computer methods. The computer application improved on the variance obtained with the hand measuring method, indicating a more precise system. Significant differences were found between readers, suggesting the need for standardization of methods for measuring alignment.
Significance: This is the first time a program measuring alignment by hand has been compared to a computer system. The outcome supports training in use of computer programs and tools for analysis of digital images using established methods.

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KNEE CARTILAGE THICKNESS MEASUREMENTS USING MRI: A 4 MONTHS LONGITUDINAL STUDY IN A GUINEA PIG MODEL OF OA

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Introduction: The aim of this study was to follow over 4 months medial tibial cartilage thickness on guinea pig OA model compared with control animals, using 3D High-Resolution Magnetic Resonance Imaging.
Methods: 15 control (SHAM) and 15 meniscectomized (MNX) guinea pigs were analyzed at 4 time-points after surgery: D15, D45, D90 and D135, at medial side of left knee. Animals joint knees were imaged *in vivo* at 7T on a Bruker Biospec system using fat suppressed 3D GEFI sequence with the parameters: flip angle of 25°, TE=3.6 ms, TR=50 ms, with 42 kHz rbw. For signal reception a 15mm receive-only surface coil was used. Sagittal

MR images were acquired with 59x59μm^2 in-plane reconstructed spatial resolution and 156 μm slice thickness. Total scan time was 45 minutes. To quantify cartilage thickness, cartilage segmentation was performed using in-house dedicated software.
Results: Means cartilage thickness measured for SHAM and MNX groups are given in Table 1.

Table 1 - Mean cartilage thickness (μm) ± S.E.M.

	D15	D45	D90	D135
SHAM	289.1±10.5	307.4±15.4	309.8±13.17	276.1±9.9
MNX	-	297.0±13.4	232.4±11.4	213.4±12.8

Note: For reasons of early meniscectomy, only SHAM group was imaged at D15.

The SHAM values show non significant 6.3% and 7.2% increase of mean cartilage thickness from D15 to respectively D45 and D90. From Day 15 to Day 135 a still non significant 4.5% decrease was found. Significant differences were found between D45 and D135 (*P<0.05) and between D90 and D135 (**P<0.01) respectively (Fig. 1). For MNX group significant 21.7% (**P<0.01) decrease of mean cartilage thickness from D45 to D90 and, then, of 28.2% (***P<0.001) at D135 were found (Fig. A). At D45 there is no significant difference found between the mean cartilage thickness measured for SHAM and MNX groups. At D90, difference between MNX and SHAM groups increases significantly up to 25% (***P<0.001). At D135, significant difference was found between the groups, with a decrease of 22.7% (***P<0.001) for MNX group than SHAM group (Fig. 2).

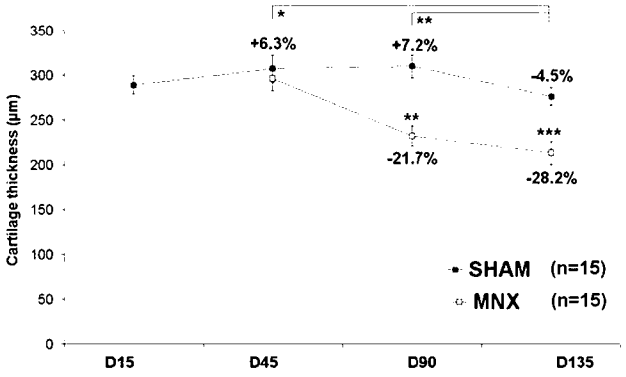

Fig. 1. Groups follow-up.

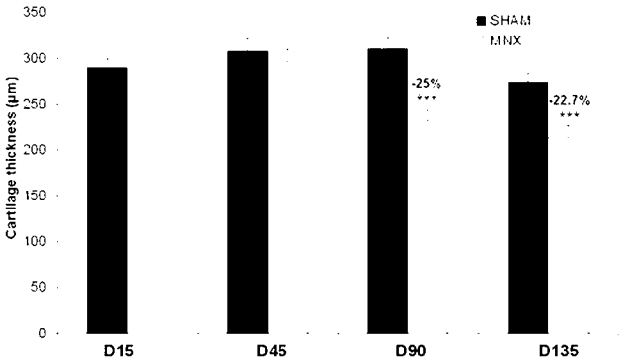

Fig. 2. MRI longitudinal study.

Discussion: Medial tibial cartilage measurements based HR MR Images enabled to monitor longitudinal cartilage thickness changes. It could be used as a non invasive tool to monitor therapy response in this OA model.

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DEVELOPMENT AND RELIABILITY OF A NEW SCORING SYSTEM FOR OA FEATURES ON MRI OF THE KNEE. BLOKS (BOSTON LEEDS OSTEOARTHRITIS KNEE SCORE)

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Magnetic Resonance Imaging (MRI) is technology that has allowed for non-invasive visualization of articular and periarticular morphology in the knee. MRI has already proven to be an important tool in improving our understanding of knee osteoarthritis (OA), by providing a sensitive non-invasive tool for the study of healthy and diseased states, and a means of assessing risk factors and the effectiveness of therapeutic interventions for prevention of pain, dysfunction, and disability in OA. However, the utility of knee MRI in the study of OA is limited by the fact that the measurements of findings have not been systematically developed, assessed for reliability, scaled, well-validated, and assessed for sensitivity to change. Recent data has suggested that there are limitations with the current methods used for scoring knee MRIs for OA features. We undertook a study to systematically develop a novel scoring method and to assess the reliability of this scoring scheme.
Methods: Initially a knee OA specific scoring scheme (BLOKS: Boston Leeds Osteoarthritis Knee Score) was developed by consensus of musculoskeletal radiologists and OA clinical researchers. Two exercises for calibration and assessment of reliability were conducted. The panel of observers then conducted standardization sessions to minimize inconsistencies after each reading exercise. After completion of these training sessions the observers scored MRI's blind to results of prior observers and patient details.
Results: A comprehensive scoring method for knee joint assessment in osteoarthritis was developed. The knee was first divided into functionally distinct anatomic regions. This instrument includes assessment of bone marrow lesions (volume, and % surface area adjacent to subchondral plate), cartilage (size of area of cartilage loss, and % of thickness lost), osteophytes, synovitis, effusion, meniscal extrusion, meniscal morphology, ligaments and periarticular features. The interobserver reliability (kappa) for all features scored was >0.6.
Conclusion: We have developed a novel scoring method for application in MRI studies of knee osteoarthritis. This method has acceptable reproducibility. We are planning further exercises to assess the responsiveness, validity and psychometric properties of this scoring technique.

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ROBUST AUTOMATIC VOLUME ESTIMATION OF ARTICULAR CARTILAGE FROM KNEE MR SCANS

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Objective: The aim of this study was to present a novel, automatic method for the segmentation of knee cartilage from Magnetic Resonance Imaging (MRI), and to investigate whether the method can differentiate a healthy population from a population with osteoarthritis (OA) using the automatically estimated volumes.
Materials and Methods: We studied 114 knees of which 51 were from healthy subjects and 63 from subjects with mild to severe OA